Seasonal Impacts of Cage Aquaculture on Water and Soil Quality in Khlong Lam Chan, Trang

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Background and Supporting Information

Currently, Red Tilapia farming in cages is a popular occupation in many areas, as it utilizes natural water sources to generate income for households, communities, and the industrial sector. However, cage aquaculture may cause environmental impacts if there is a lack of proper control and management. In particular, fish waste and leftover feed can lead to changes in water quality, such as increased levels of nutrients and chemicals, which affect aquatic organisms. Furthermore, waste that settles at the bottom of the water source can impact the soil conditions surrounding the cages, altering properties such as pH levels, nutrient content, and soil moisture. These changes can have long-term effects on the ecosystem. Therefore, studying the changes in water and soil quality from Red Tilapia cage farming is essential for providing data to assess impacts and develop environmentally appropriate management guidelines. The purpose of this project is to study the impact of Red Tilapia cage farming on soil and water. The study is divided into two protocols: a soil quality study and a water quality study within the farming areas. The soil quality study involves measuring soil compaction, soil structure, electrical conductivity, salinity, and macronutrient content—specifically Nitrogen (N), Phosphorus (P), and Potassium (K)—as well as soil moisture and temperature. This is done to assess soil suitability and potential changes resulting from fish farming activities. Regarding the water quality study, key chemical parameters will be measured, including nitrate, nitrite, ammonia, hardness, salinity, and electrical conductivity. These are indicators of water quality and suitability for aquatic life, as well as the impact on natural water sources. The data obtained from both parts of the study will provide an understanding of the relationship between Red Tilapia cage farming and the environment, serving as a guide for proper and sustainable aquaculture management in the future.

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GLOBE Badges

1. I am a Collaborator

This project succeeded through systematic teamwork and defined roles in sampling, measurement, and analysis. Every member actively exchanged ideas and supported one another, ensuring strong unity that led to achieving all research objectives.

2. I am a Data Scientist

We conducted hands-on field research, collecting water and soil data across farming and non-farming zones during both rainy and summer seasons. All data was systematically verified and analyzed against environmental standards to ensure accuracy and reflect real-world conditions.

3. I make an Impact

Our study highlights how fish farming influences changes in electrical conductivity, salinity, and ammonia. By identifying these trends, our findings provide a critical guideline for monitoring aquaculture to minimize environmental impact and maintain local ecological balance.

Data Collection Plan

1. Research Preparation & Implementation

Preparation: Select topic, review literature, define objectives, and designate sampling points.

Implementation: Plan operations, survey the site, measure water/soil/air quality, analyze data, and conclude findings.

Part 1: Air Quality

Cloud Cover: Average observations from 4 participants.

Humidity: Measure using a thermometer and hygrometer; record results.

Part 2: Water Quality

Temperature & pH: Measure at 10cm depth (wait 5 mins) and use pH paper.

Transparency (Secchi Disk): * Establish a reference point; note cloud conditions.

Lower disk until patterns disappear (Point 2), then raise until they reappear (Point 3).

Gap between P2 and P3 must be <1 m.

Perform 3 times with different observers (GLOBE protocol).

Chemical Analysis: Use specific kits or meters to test DO, EC, Salinity (hydrometer), Hardness, Nitrate, Ammonia, and Nitrite.

Part 3: Soil Quality

Structure & Consistency: Observe undisturbed soil structure. For consistency, squeeze a moist topsoil ped between fingers until it breaks.

Temperature: Use a soil thermometer (wait 2 mins).

Soil pH (1:1 Ratio): * Mix 20g dry soil with distilled water.

Stir 30s and rest 3 mins (repeat 5 times).

Measure the clear upper liquid using pH paper once settled.

Nutrients (NPK): Use an NPK test kit to measure Nitrogen, Phosphorus, and Potassium.

Description of Study Site

Table 1: Geographic Coordinates of Water and Soil Sampling Points

Water Sampling Locations	Geographical coordinates	
	Latitude (N)	**Longitude (E)**
Klong Lam Chan Fish Cage, Khok Saba Sub-district, Na Yong District, Trang Province	7.51018°"N	99.74025°E

The study area is located at the fish cages in Khlong Lam Chan, Khok Saba Subdistrict, Na Yong District, Trang Province. Fieldwork was conducted to collect water and soil samples, which were divided into 2 main sections: 1. The area above the fish cages and 2. The area below the fish cages.Water samples were collected from 4 points, consisting of the fish cage area, a point approximately 15 meters above the cages, and a point approximately 15 meters below the cages. The cages measure approximately 4 meters in size. Additionally, soil samples were collected from 4 points in the vicinity of the fish cages. The sampling period spanned from October 25, 2025, to January 25, 2026.

DATA COLLECTION SCHEDULE

Table 2: Sampling Period for Water and Soil Collection

No.	Water and soil sampling time	
	Day/Month/Year	Period
1	25 October 2025	16.00-17.00
2	29 November 2025	16.00-17.00
3	27 December 2025	16.00-17.00
4	25 January 2026	16.00-17.00

Expected Outcomes or Goals

This study was conducted to enhance the understanding of the impacts of fish cage farming on water and soil quality during the rainy and summer seasons.

Research Question and Hypothesis

Research Questions

1.How does the water quality differ among the areas above the fish cages, within the fish cages, and below the fish cages?

2. How does the water quality resulting from fish cage farming compare between the summer and rainy seasons, and how do they differ from surface water quality standards?

3. How does the soil quality in the vicinity of the fish cages differ between the summer and rainy seasons?

Hypothesis

1.Water quality parameters within and below the fish cages are higher than those in the area above the fish cages where no farming occurs.

2. Most water quality parameters in the fish farming areas fall within the criteria of the surface water quality standards.

3. It is expected that the soil quality below the fish cages is more affected by fish farming than in the area above the cages, due to the accumulation of waste from the farming process.

Result

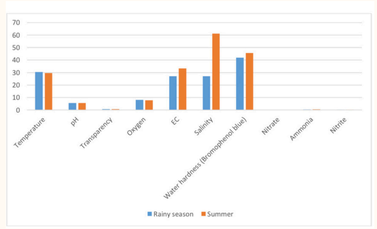
Table 3.Water Quality Study in the Lamchan Fish Tank Area

Parameter	Average Quality of groundwater used for domestic purposes		
	Above the fish cages	Around the fish cages	Below the fish cages
Temperature (◦c)	30.5 ± 0	30 ± 0.10	29.25 ± 0
pH level	6.5 ± 0.18	5.5 ± 0.27	5.625 ±0.12
Transparency(m)	0.7 ± 0.15	0.7 ± 0.10	0.7375 ± 0.12
Oxygen(mg/l)	8.13 ± 0.62	7.535 ± 0.54	8.25 ± 1.25
Electrical conductivity(µS/cm)	27.03 ± 5.98	32.625 ± 2.35	34.125 ± 1.12
Salinity(ppt)	27.0625 ± 1.82	35.5 ± 7.07	25.75 ± 0.75
Water hardness (Bromophenol blue) (mg/l)	42 ± 1.59	44.4375 ± 1.81	46.875 ± 0.37
Nitrate($NO3^-$) (mg/l)	0 ± 0	0 ± 0	0 ± 0
Ammonia($NH3$) (mg/l)	0.25 ± 0.05	0.47 ± 0.03	0.38 ± 0
Nitrite($NO2^-$) (mg/l)	0.02 ± 0	0.02 ± 0	0.02 ± 0

The results of the study found that water quality within and below the fish cages exhibited levels of Electrical Conductivity 32.625-34.125 µS/cm, Water Hardness 44.43-46.875 mg/l, and Ammonia 0.38-0.47 mg/l that were higher than those in the water above the fish cages.Conversely, the pH and Oxygen levels were lower than in the areas above and below the fish cages. Parameters such as Temperature, Transparency, and Nitrite were found in similar quantities across the areas.

Table 4.Study of water quality in the rainy season and summer of the Lam Chan Canal

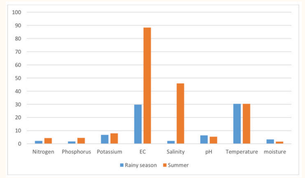
Parameter	Average Quality of groundwater used for domestic purposes	
	Rainy season	Summer
Temperature (◦c)	30.5	29.62
pH level	5.5	5.5
Transparency(m)	0.7	0.71
Oxygen(mg/l)	8.13	7.8
Electrical conductivity(µS/cm)	27.03	33.38
Salinity(ppt)	27.0625	61.25
Water hardness (Bromophenol blue) (mg/l)	42	45.66
Nitrate($NO3^-$) (mg/l)	0	0
Ammonia($NH3$) (mg/l)	0.25	0.42
Nitrite($NO2^-$) (mg/l)	0.02	0.02



Based on the figure, comparing the water quality above the fish cages in the rainy and summer seasons, it was found that Temperature, pH, Transparency, and Oxygen levels remained similar. The average Temperature ranged from 29.62-30.5°C, with a pH of 5.5 and Transparency of 0.7 m.In the summer, the values for Electrical Conductivity 33.38 µS/cm, Salinity 61.25 ppt, and Water Hardness 45.66 mg/l were higher than those in the rainy season. When comparing the water to surface water quality standards, it was found to be Type 1, representing a water source with natural quality.

Table 5.Study of water quality in the rainy season and summer of the Lam Chan Canal

Parameter	Average Quality of groundwater used for domestic purposes	
	Rainy season	Summer
Nitrogen (mg/kg)	2.13 ± 0.78	4.29 ± 1.52
Phosphorus (mg/kg)	1.75 ± 4.33	4.38 ± 1.10
Potassium (mg/kg)	6.71 ± 4.5	7.88 ± 1.83
Electrical conductivity(mS/cm)	29.69 ± 33.53	88.29 ± 3.98
Salinity(ppm)	32.13 ± 45	45.83 ± 0.18
pH level	6.32 ± 12.21	5.29 ± 0.72
Temperature (◦c)	30.33 ± 60.33	30.38 ± 0.72
Soil moisture (MC%)	33.3±61.7	16.7±12.3



From the table showing the soil quality analysis results, it was found that soil nutrient levels (N, P, K) were higher in the summer than in the rainy season. Nitrogen increased from 2.13±0.78 mg/kg to 4.29±1.52 mg/kg, and Phosphorus increased from 1.75±4.33 mg/kg to 4.38±1.10 mg/kg, while Potassium rose from 6.71±4.5 mg/kg to 7.88±1.83 mg/kg.Additionally, Electrical Conductivity (EC) and Salinity in the summer were clearly higher than in the rainy season. Electrical Conductivity increased from 29.69±33.53 mS/cm to 88.29±3.98 mS/cm, and Salinity increased from 32.13±45 ppm to 45.83±0.18 ppm.However, the rainy season exhibited higher pH and temperature values compared to the summer, and soil moisture was greater, with a moisture value of 3.33 in the rainy season compared to 1.67 in the summer. Meanwhile, the soil temperature for both seasons was similar, at approximately 30 degrees Celsius.